This manual has been scanned by the

Vickers MG Collection & Research Association

www.vickersmg.org.uk

Please support the work of the Association.

Click on the image to donate through PayPal:

Or regularly support us through Patreon:

Or make a quick, single donation:

A not-for-profit company, limited by guarantee, registered in England, Company Registration Number 07855202

NOT TO BE PUBLISHED

The information given in this document is not to be communicated, either directly or indirectly, to the Press or to any person not holding an official position in His Majesty's Service.

26/G.S. Publications/743

THIS DOCUMENT MUST NOT FALL INTO ENEMY HANDS

OPERATIONS

MILITARY TRAINING PAMPHLET No. 23

PART VIII.—INFANTRY AND ARMOURED DIVISIONS IN THE OPPOSED CROSSING OF A WATER OBSTACLE

1942

(THIS PAMPHLET SUPERSEDES THE 1940 EDITION)

Crown Copyright Reserved

Prepared under the direction of
The Chief of the Imperial General Staff

THE WAR OFFICE,
August, 1942

PREFATORY NOTE

Military Training Pamphlet No. 23—Operations—is the main title of a series of pamphlets which will contain the latest ideas on subjects dealt with in Field Service Regulations, Volume II, 1935.

Pamphlets already issued are :—

Part I—General principles, fighting troops and their characteristics.
II—The infantry division in the defence.
III—Appreciations, orders, intercommunications and movements.
IV—Protection.
V—The use of gas in the field.
VI—Withdrawal.
VIII—Infantry and armoured divisions in the opposed crossing of a water obstacle.
IX—The infantry division in the attack.
X—The infantry division in the advance.

DISTRIBUTION

All arms ... ... Scale C
O.C.T.Us. ... ... Scale IV

CONTENTS

(*Continued on page* iii)

OPERATIONS

MILITARY TRAINING PAMPHLET No. 23

PART VIII.—INFANTRY AND ARMOURED DIVISIONS IN THE OPPOSED CROSSING OF A WATER OBSTACLE

1942

1.—GENERAL CONSIDERATIONS

1. Introduction

The crossing of a water obstacle in the face of opposition is a specialized form of attack involving the closest co-operation between all arms. The object of this pamphlet is to explain a procedure which can be adapted to suit varying conditions.

While the general principles remain unaltered, modern developments demand a new technique. It is to-day more necessary than ever for the crossing to be effected expeditiously; but the difficulties have grown. Speed is more difficult for the following reasons:—

i. Both numbers and weights of fighting vehicles in formations have increased.

ii. The menace of air attack has increased the danger of dislocation from damage to crossing places.

iii. Developments in demolition technique, and the possibility of contamination by gas, have complicated the repair of demolished bridges.

Speed is more necessary because the fire power, mobility, and numbers of modern A.F.Vs. have increased the danger to a force of being counter-attacked while still divided by the obstacle.

These considerations make desirable the provision of many more and heavier bridges, and demand that as large a proportion as possible should be available in the early stages of the crossing. The commander who embarks on a crossing in the face of organized opposition without making provision for an adequate number of bridges, including a sufficient proportion capable of carrying the heavier loads, now runs a greatly increased chance of being defeated in detail.

It is emphasized, however, that no technique will be successful unless all ranks are imbued with a determination to overcome the obstacle by every means within their power. No opportunity of crossing and establishing a footing on the far bank should be missed,

whether by swimming or wading, by the bold seizure of bridges before demolition, or by improvised means, including the use of half demolished bridges or local craft.

2. Scales of bridging equipment carried in the field

The quantity of bridging equipment permanently carried in the armoured and the infantry division is sufficient to deal with minor obstacles only. Sufficient equipment is, however, carried by corps in the Bridge Company to enable divisions to compete with all normal bridging operations. Bridge Companies can be reinforced as necessary by the allotment of mobile reserve components from the Workshop and Park Company, R.E.

If equipment is to be available in the divisional area when required, initial planning must start at an early stage at corps and army level. **In order that estimates may be made of bridging material required, vertical air photographs are essential.** Because of the chance of adverse weather conditions, air photographs of major water obstacles should be demanded by army headquarters very early; if possible, several weeks before the intended operation.

3. The use of a water obstacle by an enemy opposing an advance

From the defender's point of view, water obstacles have certain definite defects, of which advantage can be taken by the attacking force :—

i. His defences can frequently be overlooked from high ground on our side.

ii. Low-lying ground is often water-logged and unsuitable for field defences.

iii. Parts of the obstacle are frequently dead ground.

iv. River bends increase frontages, may also provide salients difficult to hold, and so tend to weaken his defensive system.

v. Canal banks are difficult to cover with fire.

For these reasons, unless the obstacle is a formidable one, he may endeavour in a deliberate defence to locate his foremost defences in front of the obstacle. In that event these foremost defences must be overcome first. Their annihilation is facilitated by the difficulties the existence of a transverse obstacle within the position imposes on armoured counter-attacks.

4. Types of attack

These will vary from attacks on lightly held crossings, where the opposition can be swept aside by the enterprise and

resource of the leading troops, to attacks on well-organized defences which will require the deployment of the whole force before an assault can be launched. In view of the bridging requirements of modern formations, however, the general conduct of the operation will be the same irrespective of the degree of resistance anticipated. **Preliminary arrangements should be such that the force and equipment found by reconnaissance to be necessary can be rapidly deployed.**

Airborne forces may be used to assist in all types of attack; and the use of parachute or air landing troops in conjunction with land forces opens up entirely new possibilities.

5. Phases of the attack

Whatever the scope of the attack it will normally involve seven phases :—

i. Reconnaissance.
ii. Planning.
iii. Preparation and assembly of assaulting troops and bridging equipment.
iv. The assault.
v. Exploitation by the assaulting troops and establishment of bridgeheads.
vi. Construction of the main bridges, and crossing of the main body.
vii. Continuation of the advance, and improvement and maintenance of the communications by the engineers.

These phases are dealt with in detail in the subsequent sections.

A specimen sequence of events for phases iv, v, and vi, is given at Appendix C.

2.—RECONNAISSANCE

1. General considerations

Reconnaissance falls into two stages :—

i. The collection of general information on which the commander bases his outline plan.
ii. Collection of detailed information, the reconnaissance being directed in accordance with the outline plan.

In the attack against an organized defensive position, careful detailed reconnaissance by all arms will be necessary before the assault can be launched. Against a lightly held position the detailed reconnaissance will consist of examination of those areas where the leading troops have succeeded in

infiltrating across the obstacle, and will be concerned with the selection of bridge sites and of positions for the bridgehead defence.

2. Air

Aerial reconnaissance and air photographs are most valuable to a commander in providing him with early information about the obstacle and enemy dispositions.

Air photographs, both vertical and oblique, are also of great value :—

i. To the engineers, in providing them with information about possible bridging sites, and in enabling early estimates of bridging material to be made.

From a study of suitable vertical photographs, using the stereoscope universal and parallax bar, it is possible to calculate exactly the width of river crossings and the height of banks. The photographs also provide information about the approaches to, and exits from, possible bridge sites.

ii. To the assaulting troops, in providing them with information about the ground on the far side. Low oblique photographs will often give a very much better idea of the type of country, cover, and likely enemy strong points, than can be obtained from the study of a map.

iii. Gridded oblique photographs will often enable artillery and survey units to fix points on the far side before the attack takes place. In this event, they will greatly speed up the linking of the artillery on a common grid, and large scale concentrations and barrages will be practicable within a very short time of the guns crossing the river.

Subject to air photographs of major obstacles having been made available by army headquarters (*see* Sec. **1**, para. 2), for minor obstacles demands by lower formations should be limited to specific points. These demands can be made at short notice.

3. Leading troops

Reconnaissance should be carried out on a wide front in order to gain the maximum information, to find undefended alternative crossing places, and, where none can be found, to mislead the enemy about the intended crossing places. **Every effort will be made to reconnoitre beyond the obstacle ; experience shows that such reconnaissance is often possible, even of organized defensive positions.**

Infantry with an allotment of reconnaissance boats, and engineer reconnaissance parties, should therefore be included with the leading troops.

4. Reconnaissance parties and reports

In this operation, since all arms are very closely affected by engineer considerations, joint reconnaissance should be arranged throughout all stages.

Escorts will usually be required for engineer reconnaissance parties on their first approach to the obstacle. Early information can often be obtained by an engineer officer or N.C.O. in an armoured car, reconnaissance car, or carrier.

It is of the utmost importance to the whole operation that the required information be secured and passed back early, and units in forward areas must give engineer reconnaissance parties all possible facilities for gaining and passing back information.

In operations where airborne forces are employed, whether in a detached role or in conjunction with land forces, engineer parties for reconnaissance should be landed early.

It is the duty of ALL arms, and not merely of the engineers, to send back information on the following points :—

i. Existing bridges, fords, weirs, locks, local craft; nature and length of bridges, and rough details of any demolition carried out by the enemy.

ii. Width, depth, current, nature and slope of banks, islands, or sandbanks, and liability to tidal or other changes. As information on these points may be misleading if not obtained by actual measurements, the degree of reliability must be indicated. If this indication is given the information is always of great value.

iii. Any subsidiary obstacles (branch or tributary of river, ditches, etc.) on either bank.

5. Detailed reconnaissance

Before the detailed plan for the crossing can be made, careful reconnaissance will be necessary by all units taking part in the preliminary phases. This should be carried out by detailed reconnaissance parties made up of representatives of all arms, under cover of the leading troops, and timed to take place during the move of the main body into its assembly area. In the advance to the obstacle, reconnaissance parties should move between the leading troops and the main body. Parties should be kept as small as possible, but must include representatives of all units detailed for the assault or its support.

Before reports are received from the leading troops concerning enemy defences on the obstacle, it will often be impossible to decide whether a deliberate assault will be necessary. In the long run delay can be avoided only if previous arrangements for the detailed reconnaissance for an elaborate assault have been made. If, in the event, a deliberate assault proves unnecessary, the role of the reconnaissance parties will be to reconnoitre for bridge sites and select positions for bridgehead defence.

Depending on whether a deliberate assault is necessary or not, all or some of the following points require consideration by these reconnaissance parties :—

i. *Crossing places*

(*a*) These are the places where the assaulting infantry cross. They should be sufficiently close to protect the sites selected by engineers as suitable, technically, for ferries or light bridges, since it is in these areas that initial bridgeheads must be established.

(*b*) Tactical requirements :—

Near suitable forming-up places.
Minimum enemy resistance.
Good observation for supporting arms.
Suitable for exploitation and bridgehead defence.

Points at which leading troops have crossed may be unsuitable for exploitation. It is particularly desirable that there should be anti-tank localities immediately covering the bridge or ferry sites.

(*c*) Technical requirements :—

Good approaches and exits.
No subsidiary obstacles.
Unobstructed crossing (no islands, bars, reefs, etc.).
Banks, current, and approaches suitable for equipment available.

ii. *Objectives*

Suitable objectives for the first flight of the assault must be selected. They should not be too far ahead, but should if possible include the capture of ground from which observation can be obtained on the bridge sites, and ground between the obstacle and the assembly area, and should provide facilities for forming up and deploying subsequent flights on the far bank. The first flight do *not* halt on these objectives unless further advance is impossible without added support.

iii. *Forming-up places*

Here the assaulting troops form up for the attack, and assault bridging equipment is finally prepared for launching.

They should, if possible, be protected from ground and air observation, and a sufficient distance from the obstacle to escape detection from the noise of last minute preparation of assault equipment. Covered approaches are most desirable. For a night attack it will be advisable to mark by tapes or shaded lights the approaches to the forming-up places, and to mark if possible the best line of advance from the forming up to the crossing places.

iv. *Off-loading points*

At these points the assault bridging equipment and heavier close support weapons of the assault force are unloaded from M.T. They should be as far forward and as near the forming-up places as M.T. can go without prejudicing secrecy. Off-loading points may be on a unit or sub-unit basis. Under favourable conditions they may coincide with forming-up places, in which case they will be on a sub-unit basis. When of necessity they have to be a considerable distance in rear of the forming-up places, they may be on a unit basis, and it will usually be convenient to introduce another link in the chain by having sub-unit *assembling points* in rear of the forming-up places. Assault bridging equipment will then be manhandled forward to these points before boats are opened, etc., and the off-loading point will act as a distributing point.

v. *Fire positions for troops supporting the assault*

These include positions and O.P.'s for units providing supporting fire (artillery, M.M.G.'s, C.W. units, etc.) and sub-units providing local protection and covering fire at the actual crossing places. Some artillery positions should be well forward to cover the advance to the bridgehead positions.

vi. *Assembly area and unit harbours*

Reconnaissance of unit harbours in the assembly area must be carried out by advance parties of all units before the main body arrives. The assembly area will be laid down in divisional orders. It should be well back from the obstacle, say five miles, and should provide both maximum cover from observation and adequate routes for quick occupation and easy regrouping. If the ground or tactical situation does not permit of vehicles being taken forward of the assembly area, off-loading points will be in unit harbours.

6. Deception in reconnaissance

There will usually be favourable opportunities for the leading troops and reconnaissance parties to deceive the enemy by "phantom" attacks and reconnaissance.

3.—PLANNING

1. General considerations

The operation demands the closest co-operation between all arms, and great flexibility in the planning throughout. **These can be achieved only if plans are kept simple in outline,** though the methods for their execution must be worked out in detail.

It is more important to achieve surprise in the crossing of a water obstacle than in almost any other operation. The readiest methods of obtaining surprise are secrecy in preparation and speed in execution. It is often difficult to achieve secrecy in preparation because of the many preliminary arrangements necessary before the main assault can be launched, and the fact that technical considerations may limit the number of possible crossing places. On the other hand, **the operation presents particularly favourable opportunities for the use of deception, and full use must be made of them by all commanders.** If deceptive measures are to be effective, they must be co-ordinated by the inclusion of a " deception plan " in the divisional planning from the start of the operation. Special precautions to avoid premature disclosure of plans, combined with the skilful use of deception, are therefore required.

Speed in execution demands the most careful detailed planning, and staffs must be prepared to issue plans in considerable detail at short notice.

The divisional planning tends to fall into three stages :—

i. The plan for the advance to the obstacle, and outline plan for the crossing.

ii. The detailed plan for the assault, establishment of bridgeheads, and construction of bridges.

iii. The detailed plan for the crossing of the main body.

These stages are considered in detail in the subsequent paragraphs. Although the full procedure outlined is applicable only where there is a carefully prepared attack on an organized defensive position, a clear appreciation of all the factors involved is always necessary if essential features are not to be missed in less elaborate plans.

2. The divisional plan for the advance, and outline plan for the crossing

i. *Divisional commander's appreciation*

The first essential is an early appreciation by the divisional commander. As a result of aerial reconnaissance and a study of intelligence reports, this appreciation should

be possible before the obstacle is reached, and will influence the plan for the advance to the obstacle.

ii. *C.R.E.'s technical appreciation*

The C.R.E. must be kept fully informed from the outset and should be prepared to advise on the extent to which the technical problems of crossing will affect the tactical plan. As the result of an appreciation he should be able to indicate the probable numbers and types of bridges that can be constructed, and to give approximate comparative timings for their construction at alternative sites. Care must be taken not to underestimate timings. Even when there are no delays from enemy action, unforeseen technical difficulties will often increase considerably the anticipated time for construction.

In making his appreciation the C.R.E. will have to consider, among others, the following important factors :—

(*a*) Equipment available—limiting span of all but floating bridges may restrict the number of possible bridge sites—equipment will limit numbers and types of bridges.

(*b*) Desirability and possibility of rafting—if conditions are suitable for rafting the divisional commander will require comparative estimated timings for raft and bridge construction, comparative traffic capacity in terms of vehicles on the far bank in a given time, the number of rafts that can be constructed, and the estimated delay in completion of bridges that the use of rafts will impose.

(*c*) Approaches and exits — construction of approaches and exits is often a much longer task than the actual bridge construction. For this reason it will usually be desirable to site the heavier bridges, at least, on, or adjacent to, demolished bridges, though for bridges constructed within range of enemy artillery it may be desirable to avoid these sites as they will have been pin-pointed.

(*d*) Unloading facilities—sites must provide facilities for unloading bridging vehicles, or the time of construction will be enormously increased.

(*e*) Subsidiary obstacles—the existence of a subsidiary obstacle close to the primary one adds greatly to the difficulties. Before construction of a heavy bridge over the second obstacle can begin, it will probably be necessary to complete at least a light bridge over the first one.

(*f*) Engineer units available—a reserve must be retained to deal with work which cannot be foreseen until detailed ground reconnaissance of the far bank can be made.

iii. *Divisional outline plan*

Having decided the number and types of bridges (and rafts) to be built and selected the sites which are most suitable tactically and technically, the divisional commander must make an outline plan. Guided by the outline plan, the leading troops and detailed reconnaissance parties will be able immediately on reaching the obstacle to start the reconnaissance on which final plans for the assault and construction of bridges depend.

It may sometimes be possible to seize bridges intact; although every effort should be made to achieve this result, plans must NOT rely on it. Reconnaissance and preliminary arrangements should be so organized that there is no delay in the construction of the bridges should they be required.

iv. *Decentralization of assault and bridging equipment*

Against a well-organized defensive position, where the deployment of large forces is necessary before the attack can be launched, time and information should permit of the assault and bridging operation being planned as a whole. In these circumstances bridging will usually be done under divisional control, and final allotment of equipment will not be made until reconnaissance is completed.

Against less highly organized positions, in order to help leading troops to seize opportunities for infiltration, any assault bridging equipment available should be decentralized before the obstacle is reached. If this decentralization is not effected, the equipment will rarely arrive when required. Similarly, light bridging and rafting equipment and tank assault bridges may be allotted to brigades, particularly when operating on wide fronts. Nevertheless, unless very light opposition is anticipated, it will be advisable to retain a proportion of equipment and engineers under divisional control until it is seen at what points success has been achieved, and until detailed technical reconnaissance of the obstacle has been made.

v. *Summary of points for consideration in framing divisional outline plan*

(*a*) Composition of leading troops and reconnaissance parties.

(*b*) Any special orders to leading troops or airborne forces to seize bridges intact, or for other roles.

(*c*) Outline deception plan.

(*d*) Forward assembly area for the division, and reconnaissance of unit harbour areas.

(*e*) Number and load classification of bridges (and/or rafts) it is proposed to build, and probable sites.

Equipment will usually limit the number of heavy bridges that it is possible to build. The siting of the heavy bridge, or bridges, will require careful consideration both from the tactical and technical points of view, and detailed orders will be necessary for the routing of the heavier loads (Class 24 armoured division and Class 40 infantry division).

(*f*) Troops detailed to capture and protect bridgeheads and details of bridgeheads they are to establish. Approximate frontages on which obstacle is to be crossed, objectives, and troops allotted for support of the crossing, including general role.

(*g*) Allotments or provisional allotments of assault equipment and bridging equipment. Allotment of reconnaissance boats.

(*h*) Position in the line of march of vehicles carrying bridging equipment. (Assault and tank assault bridges, light rafts, light bridges, heavy rafts, and heavy bridges.) Each class will probably need separate treatment, depending on the outline bridging plan. The correct initial positioning is of vital importance to eliminate delay later.

(*j*) Arrangements for move up of any bridging equipment and engineers allotted by corps for the operation.

3. Divisional detailed plan for the assault, establishment of bridgeheads, and construction of bridges

i. *Lightly held crossings*

Against a lightly held crossing success will depend on the rapid reinforcement of those parties which have established a footing on the far bank. The operation as a whole must be pushed forward rapidly, in order to reduce the dangerous period during which the leading troops are without adequate support. Brigade commanders and their engineer advisers must be well forward in order that rapid decisions can be taken. The degree of success obtained by the leading troops, or technical considerations, may necessitate revision of the outline bridging plan. The divisional commander with the C.R.E. must also be well forward to ensure that any reserves of bridging equipment and engineers can be suitably employed, and that plans for the construction of the heavier bridges can be completed.

ii. *Organized defensive positions*

When a deliberate attack must be staged, the operation can be planned as a whole and greater consideration can be given to technical factors influencing the selection of bridge sites.

As a result of ground observation and reconnaissance by parties from troops nominated for the attack, the divisional commander will confirm, modify, or amplify the outline plan. Although the bridging plan, including reinforcement of bridgeheads, can and should be made in considerable detail, it must be sufficiently flexible to allow adaptation to meet any unexpected successes or failures that may occur in the assault.

iii. *Time selected for the crossing*

While crossing the obstacle the assaulting troops are extremely vulnerable, and in face of strong opposition must be covered either by darkness or by the extensive use of smoke. Many successful crossings have been made by day even in the face of strong opposition, and night crossings should not be accepted as the inevitable answer to the question of timing.

The following are some of the more important factors affecting the time selected for the crossing. They are not conclusive, and many are conflicting. Every situation must be treated on its merits.

(*a*) *Surprise*

Secrecy in preparation. It will rarely be possible to conceal the intention to cross, and surprise as to time and place must be sought. If the enemy cannot be denied air reconnaissance it will be very difficult to conceal the preparations for a deliberate assault, unless they are carried out under cover of darkness, or in unfavourable flying conditions. Against less highly organized defensive positions an assault, launched quickly after reaching the obstacle, may achieve the necessary surprise.

Speed in execution. This is essential, or the advantages of initial surprise will be lost. Daylight favours speed.

(*b*) *Cover for the assault*

Darkness, unless extensive use of smoke is possible, is likely to offer the best cover. A morning mist, especially if it can be unobtrusively thickened and prolonged by the use of smoke containers, will provide an excellent screen.

(*c*) *Exploitation*

Light will be necessary for the continuation of the advance after the capture of objectives by the

first wave of the assault. If the assault has been carried out by night there are advantages in this exploitation taking place at first light, when the defender cannot direct aimed fire.

(*d*) *Air attack*

Against an enemy having air superiority, the difficulties of constructing and maintaining the bridges by day may compel their construction, and the passage of the main body over the obstacle, under cover of darkness. These conditions favour an afternoon or evening assault.

(*e*) *Anti-tank defence at bridgeheads*

Bridges, both during and after construction, are themselves vulnerable to tank attack. Darkness is unfavourable to tank operations; if bridges or rafts can be built under cover of night, and tanks and anti-tank weapons moved over the obstacle before first light, the danger from tank attack is lessened.

(*f*) *Type of obstacle*

Assault under cover of darkness adds very considerably to the technical difficulties of crossing the obstacle by boat or raft. Under certain conditions (e.g., swift current, high banks with few landing places) it may be inadvisable to attempt a night assault, though known technical difficulties, if provision for them can be made, are sometimes to be preferred to unknown tactical ones (e.g. Wolfe and the Heights of Abraham).

(*g*) *Weather*

Fog provides the ideal conditions, having all the advantages of night and few of the disadvantages.

The phase and position of the moon will be important in determining the best time for the night assault. Complete darkness makes both the assault and the construction of bridges extremely difficult; while full moon lessens very considerably the chances of achieving surprise in the assault, and favours night bombing. Quarter moon, behind the attackers, provides the most favourable conditions, but as it shines for only half the night, the hour at which it rises and sets, and the orbit through which it moves, must be considered.

The strength and direction of the wind may be unfavourable to the use of smoke, making a night assault advisable.

Mist and rain may restrict enemy air reconnaissance, making secrecy in a daylight assembly possible.

(*h*) *Ground*

Close country will lessen the danger of assembly preparation by day being spotted from the air, will complicate the problems of the defence, and facilitate infiltration.

(*j*) *Bridge construction*

If construction is to be by night the time required will be greatly increased. (Even a little moonlight considerably speeds up night bridging).

iv. *Summary of points for inclusion in divisional detailed plan*

The following points should be considered :—

(*a*) Bridging plan, numbers, types, and sites of bridges (and rafts) to be built. Engineer units detailed for construction.

(*b*) Bridgeheads to be established, and arrangements for their establishment.

(*c*) The commander who will give the order to the engineers at each bridge site for work to start on the bridge or raft.

(*d*) Orders for the movement of engineer units, and the bridging equipment allotted to them, to assembly areas forward of the main divisional assembly area, and the routes along which they will move from them to their respective bridge sites.

(*e*) Orders for collection of assault bridging equipment after crossing.

(*f*) Arrangements for anti-tank and A.A. protection of the crossings.

(*g*) Scale of vehicles which units may take forward of the assembly area for the attack (i.e. before serials are ordered forward on completion of the bridges).

(*h*) Outline of traffic control arrangments, including forecast of order in which serials will cross the obstacle.

(*j*) Administrative arrangements.

(*k*) Intercommunication.

In addition, when a deliberate assault is necessary :—

(*l*) Assault plan, including assault troops, arrangements for support of the assault, frontages, objectives, allotment of assault equipment, rendezvous where assault equipment will be handed over.

(*m*) Zero hour for the assault.

4. The divisional plan for the crossing of the main body

Whether the crossing has been forced in the face of major or minor opposition, there will be little difference in the planning of the crossing of the main body. The planning and control of the move of reserves sent forward for exploitation across the obstacle by the main routes and bridges, and the move of the main body, will always be a divisional responsibility. It may on occasions be simpler to delegate detailed arrangements to the leading brigade or brigades, but it is better to centralize control as far as possible.

Although probable bridge sites, and estimates of the time by which bridges may be completed, can be given by the engineers early on, all such forecasts are liable to be upset. It is impossible, therefore, to make the complete divisional plan for the crossing of the main body until it is known definitely which bridge or bridges will in fact be completed, and when they will be opened to traffic. This information will not be available until work is well advanced.

It is, however, possible and necessary for the staff to prepare beforehand approximate time-tables worked out on a zero basis. When the bridges are nearing completion, orders can then be issued quickly.

The time the main body takes to cross will depend largely on traffic control organization and on the march discipline of units. These subjects are dealt with in detail in para. 8.

During the final stage of the operation the improvement and maintenance of communications may absorb a considerable proportion of the engineers.

The divisional plan for the crossing of the main body should cover the following :—

i. Plan for exploitation.

ii. Harbour areas, or dispersal points, on the far side of the obstacle.

iii. Routes and timings for all serials over the obstacle.

iv. Traffic control arrangements, including allotment of signal communications, allocation of provost personnel to bridges, and, if necessary, of staff officers to specific crossings.

v. Arrangements for ground defence of each bridge against enemy airborne troops or sabotage.

vi. Arrangements for maintenance and improvement of communications.

vii. Arrangements for recovery of bridging materials.

5. Anti-aircraft defence

There are three areas particularly vulnerable to air attack: the assembly area on the near side of the obstacle, the communication defiles at and including the bridges, and the harbour areas on the far side during and after the crossing of the main body. Of these the communication defiles at the bridge sites are by far the most vulnerable, since the other areas can usually be dispersed and concealed.

Bridges provide small targets, and the main danger of air attack will come from low flying aircraft. Floating bridges are particularly susceptible to incendiary bombs and mines, and both bridges and defiles to cannon and machine gun attack.

In addition to the protection afforded by L.M.Gs. and rifle fire, important bridges will require light A.A. guns for the defence of the bridges, their approaches and their exits, both during construction and when the main body is crossing. Reconnaissance for gun sites should be carried out as early as possible, in order that guns for the far bank can take up position as soon as the assault troops have established themselves. They can then give protection during the construction of the bridges. As a secondary role anti-tank defence of bridge sites is also most important. If possible, guns should be ferried across early, and not wait for the construction of the light bridges.

The bridges and their approaches are vulnerable to air attack by night if the moon is full, or if flares are used. The A.A. guns cannot fire with any degree of accuracy at night. Mist will provide valuable cover, and as most water obstacles have a prevalent "river" mist at certain times of the day, sources of local knowledge should be tapped for details. When the danger of enemy air attack is great and conditions are favourable (e.g. full moon), the use of smoke containers, generators, and similar apparatus, if available, in conjunction with the mist should be considered.

In addition, the maximum support will be required from our own air force to intercept raiding and reconnaissance aircraft.

6. Anti-tank defence of bridgeheads

The anti-tank defence of bridgeheads is of particular importance. It will be of the greatest assistance if the earlier bridges can be so sited that their approaches are covered by anti-tank localities, or localities which can be readily developed by using anti-tank mines.

Anti-tank guns should cross as early as possible in the assault by improvised rafts or other means. They should not wait for the construction of the bridges or raft ferries.

Trucks carrying anti-tank mines may have high priority when bridges or rafts are constructed, or mines may be taken across by hand.

The divisional commander should aim at getting a proportion of his tanks across the obstacle as early as possible, for the purpose of providing the best anti-tank defence. Tank assault bridges or, if the gap is too wide, heavy pontoon rafts, can be used for this purpose.

7. Intercommunication

There are certain special features in this operation for which provision should be made :—

i. Commanders must be kept informed of the situation on the far bank, particularly in the early stages. Until the light bridge is constructed the use of D.R.s. is restricted ; adequate provision for wireless communication must therefore be made, sets being taken over early in assault boats or by other means.

ii. The signal resources of the engineers are likely to prove inadequate. Signal centres will be required near the proposed bridge sites. Communication between the field companies, these signal centres, and the local commanders who will decide when bridging operations will begin, is necessary. Otherwise time will be lost in ordering forward the main bodies of the field companies and the bridging equipment allotted to them. The C.R.E. must also be in touch with his field company commanders, who will be forward at the relevant brigade headquarters or signal centre near the proposed bridge sites, and with the main bodies of the field companies. Communication between the signal centres and divisional headquarters is necessary, in order that definite orders for the move of the main body may be issued the moment progress on the bridges permits.

iii. For the move of the main body over the obstacle a traffic control system with adequate means of communication is required. (*See* para. 8 and Appendix "A".) The communications shown in the diagrams at Appendix A represent an ideal which should be implemented as far as signal resources permit. In view of the importance of having an efficient traffic control organization, it may be desirable on some occasions to withdraw wireless sets from formations, or to use those of reserve formations.

It will usually be possible to combine many of the requirements under ii and iii above.

8. Traffic control

i. *The traffic control system should provide for :—*

(*a*) Control of movement of bridging equipment up to selected forward harbours near bridge sites before bridge construction has begun.

Provost personnel should accompany bridge equipment vehicles—which should have priority on the roads.

(*b*) Control of the movement of serials from the assembly area over the obstacle to ensure that there is no bunching at the defiles, or delay in crossing.

(*c*) Move of units and M.T. over the obstacle in the order which suits the tactical situation. It must be possible to make rapid alterations to previously planned priorities.

(*d*) Diversion of traffic from one crossing place to another in emergency.

(*e*) Direction of serials to bridges in accordance with vehicle and bridge classifications.

(*f*) Control of returning traffic (military bridges allow of one-way traffic only).

ii. *Layout*

The system, consisting of a regulating headquarters, sector controls, and traffic posts must cover at least one route forward to each of the crossing places and one lateral on each side of the obstacle. In order to save signal resources, regulating headquarters is best sited at, or adjacent to, advance divisional headquarters, and must be operated by a staff officer who can give immediate decisions on behalf of the divisional commander. Each route is controlled by a sector control, with traffic posts at the junctions of the main routes and the laterals on each side of the obstacle, and on the bridges. With this layout traffic can be diverted from one crossing to another if a bridge is damaged.

As there is always a possibility of delay or congestion at the bridges from enemy action or other causes, it will be advisable to detail a staff officer to supervise at the site, in which event a second sector control can be sited there.

This organization should be set up as early as possible and carried forward of the obstacle as soon as the tactical situation permits.

Alternative typical layouts are shown in diagrams at Appendix A.

iii. *Procedure*

The routes forward to the bridges must be strictly reserved, and serials must at all costs avoid getting on to these routes until ordered forward by control.

Units deployed in the forward areas in support of the assault, and units in the assembly area, must be in touch with sector controls, either by wireless or by having a liaison officer or motor cyclist at the nearest sector control or traffic post to receive the order for his unit to move. Orders to move are given by sector controls under instructions from regulating headquarters.

Beyond the forward traffic post brigades will take over and will arrange guides to lead units to their dispersal points.

iv. *Communications*

Regulating headquarters must be in touch with advanced divisional headquarters and with each sector control. Sector controls must be in touch with their traffic posts.

If in the more deliberate crossing wireless silence has been enforced up till the assault, communication will have to be by line ; it will, however, be advisable to have wireless as an alternative. Communications between regulating headquarters and sector controls must have priority.

v. *Bridge and vehicle classification*

The classification of military bridges is given at Appendices D and E. Since each bridge constructed will be designed to carry a specified load, careful arrangements are necessary to prevent the passage on to the bridge, or on to the approaches to it from which no diversion is possible, of any load greater than that for which it has been classified. A figure indicating its load classification is marked on the front of every vehicle, and the limiting classification of the vehicle it will carry (bridge classification) is marked on the approach to every bridge. Unit commanders are responsible that the normal loading of vehicles is not exceeded, and the divisional staff that vehicles whose weight exceeds the bridge classification are not routed by that bridge. Vehicles which are too heavy for a bridge must not be allowed to start on that route, since their diversion at the bridge site (often on a narrow made-up approach across a marshy field) will cause considerable delay.

vi. *Traffic control at bridges and raft ferries*

The staff, engineers, traffic personnel, and units all have their specific responsibilities in connection with the control of traffic at the actual crossing places ; these are summarized at Appendix B.

vii. *Marking of bridges and approaches at night*

Some method of marking the approaches and bridges, especially military bridges, at night will be essential if the tactical situation does not permit of the use of headlights. Balisage lamps placed at close intervals are most satisfactory for wheeled vehicles. For A.F.Vs. some form of raised visible sign is desirable both on the bridge and on the adjacent approaches.

SECTION 4.—ASSEMBLY AND PREPARATION

1. Assembly area

Whatever the scale of the attack, an assembly area some distance short of the obstacle will be required. Its functions are :—

i. To provide harbour areas where divisional engineers will be joined by the bridging equipment allotted to them for the operation by higher formations.

ii. To provide harbour areas where field companies will be joined by the bridging equipment sub-allotted to them for the operation.

iii. To provide harbour areas for M.T. of units making the assault and supporting it.

iv. When a deliberate attack is necessary after an approach march of any appreciable distance, to provide an area where the necessary reorganization, regrouping, and preparation of units detailed for the attack can be carried out, and from which they can deploy.

When the ground and tactical situation permit, certain vehicles may be taken forward of the assembly area to "off-loading" points. The number must, however, be restricted, or congestion of routes will occur, and they must return to the assembly area when unloaded. This restriction applies to all units, including the leading troops, who should take forward essential fighting vehicles only. The requirements of the assembly area are :—

i. Good road facilities.

ii. Cover from ground and air observation.

iii. To be sufficiently far back not to provide any direct indication of the front selected for the crossing.

iv. To be out of range of enemy divisional artillery.

2. Distribution of troops

The troops can be conveniently divided into the following categories :—

i. Assault force.
ii. Supporting troops.
iii. Engineer bridging parties.
iv. Reserves.
v. Administrative units and administrative vehicles of fighting units.

These are considered in detail in the subsequent paragraphs. Although the remarks apply in full only in the instances where deployment for a full scale attack is necessary, the principles apply for all types of attack.

3. Assault force

i. *Composition.*—The assault force will consist primarily of infantry, with such close support weapons as can be manhandled and ferried across in assault craft or on improvised rafts before the construction of the bridges or bridge rafts. Anti-tank guns will certainly be required. When minefields have been located on the far bank, engineer detachments must accompany the assaulting infantry to clear lanes.

Under favourable conditions it may be possible to get tanks across early, using tank assault bridges or rafts, in which event a proportion should be included in the assault force with the primary role of extending the bridgehead and the secondary role of countering action by enemy tanks. The tank assault bridge, however, cannot be launched, or rafts constructed, until the infantry have established at least a small bridgehead.

ii. *Close support.*—The assault force can be divided into the assaulting parties which cross in the first wave, and parties which, if required, provide local protection and close support for the first wave from the near bank. These will cross in subsequent waves. The parties detailed for close support should be under the same commander as the assaulting parties they are covering, since the closest co-operation between the two is essential. Carrier platoons, dismounted, and mortar platoons are suitable for this role : and at lightly held crossings where a large supporting force has not been deployed, tanks allotted to the assault force, and units of the reconnaissance or armoured car regiment, might be used.

iii. *Assembly.*—From the assembly area the assaulting and close support parties move forward to the previously reconnoitred forming-up places, or sub-unit assembling points, and then their forming-up places.

The troops detailed for close support, if not already in position, should move forward and take up their fire positions shortly before the assaulting parties leave their forming-up places.

4. Supporting troops

These consist of supporting arms (artillery, C.W. units, M.M.Gs.) and their role is to provide supporting fire, first (*if* required and ordered) for the assault, then for the advance from the far bank to bridgehead positions; and, finally, to support the assaulting troops in case of counter-attack. The supporting force must be deployed before the assault troops move forward from their forming-up places. Only essential vehicles should be moved forward of the assembly area. Adequate time must be allowed for their reconnaissance and deployment. Every possible precaution must be taken to avoid giving away the selected crossing points.

Air support is dealt with in section **5**, para. 6.

5. Engineer bridging parties

The construction of modern military bridges and rafts demands the concentration of all engineer resources under the direct order of the C.R.E. **An advanced engineer party for each bridge or ferry site must be deployed forward close behind the leading assault troops to complete the necessary detailed ground reconnaissance of the site, and to start on work preparatory to the arrival of the main bodies of field companies with the bridging equipment.**

Engineer reconnaissance parties and advance parties will usually be decentralized in the early phases for the movement forward, but neither they nor the engineer units put under command of lower formations or units for the approach should be diverted to other tasks without permission of the divisional commander.

6. Reserves

Reserves must be maintained for exploitation and to deal with unexpected situations. A proportion of engineers and bridging equipment should, if possible, be included. They should be held well back in the assembly area, from where they can be moved forward as soon as the bridges are completed.

7. Administrative units and A and B echelon transport

It will usually be best initially to keep administrative units, and also "B" echelon transport (under brigade or divisional

control), well in rear of the assembly area. They can conveniently be moved forward to the assembly area when the bridges have been established and the crossing of the main body is well advanced.

It will also frequently be of advantage to brigade "A" echelon transport, and to hold it in the assembly area until all "F" groups have crossed. In this way the crossing of units with essential fighting vehicles is expedited.

8. Assembly of assault and bridging equipment

i. *Assault equipment.*—If military assault equipment is required for the assault, early arrangements must be made for any necessary reinforcement of equipment carried in the division to be brought forward from the corps bridge company R.A.S.C. From the bridge company the required equipment moves to the divisional field park company, where it is checked, reloaded if necessary, and guided forward to brigade rendezvous by motor cyclist guides of the field park company. The equipment is handed over by the engineers to brigades in the assembly area, or at the previously arranged rendezvous. When conditions permit of its being moved further forward in M.T. for delivery at unit off-loading points, it will probably have to be redistributed at the brigade rendezvous into unit transport for carriage forward, as the loading of the lorries of the bridge company will not always be on a unit basis. At the off-loading point the equipment is unloaded, allotted to sub-units, and carried forward to forming-up places or assembling points where assault boats are opened, and kapok formed into bridges ready for the carry forward to the launching points, or forming-up places.

When off-loading points are some distance from forming-up places and assembling points are being used, it will usually be convenient to use reserve units or sub-units for the man-handling forward of equipment from the off-loading points to the assembling points. The sub-units detailed to cross in the first wave of the assault then collect their bridging equipment at the assembling points, and carry it forward to the forming-up places. Boats are opened and kapok assembled either at the assembling points or forming-up places, according to the distance from the obstacle of the forming-up places.

ii. *Bridging equipment.*—Since arrangements will have to be made to draw on the corps bridge company, and on some occasions the engineer base dumps, for any but minor obstacles careful arrangements for the move forward of the vehicles carrying the equipment will be necessary. It is advisable to mark the bridging vehicles with a special sign, to ensure that they are given the necessary priority on the roads, and to

attach provost personnel to ensure that the columns are not delayed.

Under favourable conditions even gliders may be used to bring up bridging, thus avoiding congestion on the roads, and eliminating the inevitable time lag that occurs when it is not positioned well forward and has to be moved by road. Suitable landing areas must, however, be available close to bridge sites if time is to be saved.

In the assembly area bridging material from the bridge company joins the divisional engineers, and together with the divisional equipment may be further sub-allotted and moved to the field companies who are to use it. Reserves of equipment must also be allotted.

As and when the tactical situation permits, it may be desirable to move the main bodies of field companies further forward to individual assembly areas nearer the bridge and ferry sites. If firm allotments of bridging equipment have previously been impossible to make, the equipment is subsequently sent to join them in these *forward assembly areas*. The decision whether forward assembly areas are necessary will depend on the distance of the divisional assembly area from the obstacle, and the signal facilities available for communication to these areas.

From the forward assembly areas (or the divisional assembly area where there are none), the bridging vehicles move to individual harbour areas near the bridge or ferry sites. Here the lorries are marshalled and called forward, one or two at a time as requested, to the site for unloading. These *marshalling harbours* should be close to the site, but remote enough to avoid congestion at the site itself. Should the forward assembly areas be sufficiently near the bridge sites, marshalling may take place here and additional forward harbours will be unnecessary. After unloading, empty vehicles return to the same or another harbour depending on the traffic circuit available. Provision of harbours near sites must be made early. They must be kept clear of other troops.

5.—THE ASSAULT

1. Types of attack

i. *Coup de main*

No opportunity of capturing bridges intact or incompletely demolished must be missed. A.F.Vs. and mobile troops may be pushed well forward to surprise the enemy and seize the bridges before demolition parties can blow some or any of the charges. Every ruse and guile should be employed by these troops. In withdrawals one or more of the planned demolitions frequently miscarries; such chances must be seized.

Airborne forces can be used to anticipate the enemy at an important crossing. An attack by these troops can be delivered by night and from the enemy side of the river.

The capture by the Germans of vital crossings over the Albert and Corinth canals are examples from this war.

Although opportunities for this form of attack are most likely to occur against lightly held positions, they may on occasions be possible against an organized defence, particularly when the obstacle is sited within the defensive position.

ii. *Infiltration*

It is the personal responsibility of the local commanders of the leading troops to make every effort to get across the obstacle regardless of what is happening on their flanks. It is only as the result of their energy, resource, and determined action that the weak spots can be found. The obstacle should be tapped on a wide front and every opportunity to cross seized. Information must be passed back quickly in order that any success gained can be exploited and bridgeheads established. Success signals may be arranged for this purpose.

History has many examples of crossings having been made by bridges incompletely demolished (Aisne, 1914), footbridges, lock gates (Canal du Nord, 1918), weirs (Meuse, 1918), etc., overlooked by the enemy in his demolition plan (possibly not marked on the map), and by boats left on the near bank. It should be remembered that maps are usually many years out of date, and that they never give negative information.

iii. *Quick assaults*

Should no point be found where an unopposed crossing can be made, local commanders of the leading troops should at once select points where the defence appears weakest and, concentrating all available resources, attempt to cross at these points.

Even against organized defensive positions it may, with aggressive reconnaissance, be possible to find a weak spot and so to effect a crossing. Although it may not be possible to establish bridgeheads without staging a full scale attack, these crossings will have a high moral effect on the enemy, assist technical reconnaissance of the obstacle, and will materially help the main assault. If assault boats are not immediately available, the leading troops must make every effort to cross by other means—swimming if necessary.

iv. *Deliberate assaults*

Only when the leading troops have been held up and are unable to establish bridgeheads should the divisional commander *complete* the arrangements for a deliberate assault.

In a deliberate assault, airborne forces may be used to cut communications, attack headquarters, and to harass and delay enemy reserves.

2. Crossing places

Apart from technical considerations, a decision on the width of the front on which the assault as a whole should be launched will depend on a consideration of three factors :—

i. It should be on as wide a front as resources of infantry and equipment will allow, in order that premature disclosure in one area does not prejudice surprise at the others.

ii. It must not be so wide that the commander risks defeat in detail by units being out of supporting range of one other.

iii. It must be sufficiently wide to provide a bridgehead large enough to cover the construction of the bridges considered necessary in the early stages of the operation.

Within units, crossing *places* for sub-units (companies) must be sufficiently close together to make co-operation between parties possible soon after crossing.

The individual crossing *points* within sub-units must be so concentrated that sub-unit commanders can quickly gain control on the far bank. While it is desirable that all points should be within sight of one other, they should not all be vulnerable from the same enemy post if circumstances permit.

Individual boats must cross from the same starting point to the same spot on the far bank on all their journeys ; otherwise platoons and companies will become mixed. In the dark with a stream running such precision will be difficult and engineer assistance may be required. With extremely fast currents a night crossing may be rendered hazardous.

A beachmaster should be appointed for each crossing *place*. He should control the crossing of the second and subsequent flights. This control he exercises from the near bank. A small reserve of equipment may be held to allow for boat casualties in the first flight. Kapok bridges when available, and not used in the first flight, constitute a convenient reserve.

3. Objectives

There are three successive objectives :—

i. A position which will eliminate effective direct small arms fire against the crossing sites.

ii. A position which will eliminate ground observation of artillery fire on the selected bridge sites, and can be supported by field artillery from positions on the attacker's side of the river.

iii. A position which will eliminate all artillery fire on the bridge sites, and provides the space necessary for the manœuvre of the main body on the enemy side.

The attack should aim at going forward as rapidly and as deep as possible. The choice of initial objectives will depend on the anticipated resistance, the width and difficulty of the obstacle, and the facilities available for crossing. If the obstacle is narrow, the enemy resistance weak, and the assault equipment available is adequate, subsequent waves may be able to cross over with such speed that the impetus of attack can be maintained without any appreciable halts on intermediate objectives. In such circumstances the advance of the leading troops will automatically cover the passage of the subsequent waves. If, however, conditions are less favourable, it will be necessary to halt on intermediate objectives to cover the crossing of reserves before the advance to the final objectives can be continued.

In any event, the proportion of assault equipment kept in reserve should be small, in order that the first wave of fighting soldiers landed on the far bank may be as strong as possible.

In a night crossing, the depth of the initial objectives will be limited by the extent to which the advance is considered possible without loss of control. In any event, the choice of initial objectives should aim at the crossing sites being protected from aimed small arms fire, and when possible from observed artillery fire, and should allow for sufficient space for local reserves to deploy after crossing.

4. Supporting and covering fire

When the assault is made by night it will normally be best to attempt a " silent crossing " without fire support. If supporting and close support troops open fire they destroy the chance of obtaining complete initial surprise, while their fire can have little more than a moral effect because of the difficulty of seeing targets. But fire must be available at short notice should surprise fail, and troops must be deployed ready to give it. The decision when the supporting and close support troops open fire will probably have to be made by the divisional commander, or at the lowest by the commanders of the leading brigade or brigades, since it will be difficult for local commanders to decide at what stage surprise has been entirely lost.

For a day assault the maximum amount of supporting fire will be required, **including a liberal use of smoke** if weather conditions permit. Fire should be opened on centres of resistance shortly before the assault is launched. It will usually be most economical for division to control supporting arms for the assault, and to decentralize a proportion as soon as the obstacle is crossed.

The infantry weapons providing covering fire should be sited close to the crossing places, so that the progress of the assaulting parties can be watched. For a day assault, the time when covering fire is most likely to be required is when the leading sections are launching the boats. Fire must, however, be confined to the immediate front of the sub-unit concerned in order not to interfere with other launching parties. By night, if fire is opened by the enemy it must be disregarded until permission to open fire has been given.

The supporting fire from artillery, M.M.Gs., mortars, and C.W. weapons should be from positions well forward. If registration of known centres of resistance is carried out it must be done as unostentatiously as possible, and should not be confined to areas in the neighbourhood of selected crossing places. Occasional bursts of fire on targets away from the river bank may help to deceive the enemy and to cover any noise of the assault crossing.

5. Air support

For a day assault, " ground strafing " from the air and close support bombing on known centres of resistance will be of great value. Effective smoke screens can also be laid by aircraft. These may be particularly valuable when the direction of the wind is unfavourable for the production of smoke screens by artillery.

For a night assault, low flying aircraft might be detailed to cover the noise of M.T., tanks, etc., moving into position.

6. Engineers in the assault

The infantry must be prepared to operate the assault bridging equipment without engineer assistance except when the swiftness of the current or similar conditions make skilled engineer watermanship essential. The use of engineers in this role will be at the expense of bridging commitments, for which they are all required, and is therefore to be avoided if possible.

Parties of engineers will follow closely in rear of the assaulting troops in order that work on rafts and bridges may start as soon as a bridgehead has been established Against a well organized defensive position the establishment of a

bridgehead may provide the first opportunity the engineers will have of making a close detailed reconnaissance of the obstacle and its approaches and exits, other than from air photographs.

6.—THE ESTABLISHMENT OF BRIDGEHEADS

1. General considerations

Surprise, which is achieved in the assault by secrecy and deception in preparation, must be maintained in this phase by speed in execution. The need for speed and more speed exists in this operation as in all others. Against a strong defence, the assaulting troops must be established before the enemy can launch his counter-attacks; against a retreating enemy, the main striking force must get over the obstacle as quickly as possible. Speed in executing this stage usually demands wide bridgeheads to cover the large number of bridges necessary to pass a formation rapidly across.

2. Action of assault troops on crossing

Once the far bank has been reached, and sub-units have re-formed and are under control, they should move forward to their objectives.

Before the crossing some troops should be detailed to clear the far bank of enemy troops in the vicinity of the crossing places, and arrangements should be made for troops assaulting at adjacent places to gain touch with each other.

The attack from the crossing places will be carried out under the same principles as for a normal attack, the method depending on the degree of resistance expected.

3. Reinforcement of assault troops

As soon as any troops are established on the far bank they must be reinforced by all available reserves in the hands of the local commander, to enlarge the bridgehead. Brigade headquarters must be right forward from this point until the brigade has crossed, to ensure that reserves can be rapidly diverted to meet any changes in the tactical situation.

Improvised rafts can be made by using reconnaissance boats, assault boats, or kapok equipment, in order that infantry close support weapons and anti-tank guns can be ferried without waiting for the construction of the bridge or heavier rafts. Anti-tank guns in particular must be got across early. On the other hand, it will not at this stage be possible to get trucks across, or carriers unless they have first been fitted

with kapok floats. Weapons, ammunition, wireless sets, etc., will all have to be manhandled.

When technical considerations permit, it is quicker to get reserve infantry across by kapok assault bridge than by assault boats, and kapok is better suited to this role than to the initial assault.

If the crossing has been successful in some places, but not in others, it may be desirable to detail parties from subsequent waves to work to the flanks from points where success has been gained, in order to open up further crossing places.

Tank assault bridges, when available, provide a means of getting tanks and wheeled vehicles across the obstacle early; but, when the obstacle is too wide to be bridged by them, tanks must be ferried across on rafts, if conditions permit, or wait for the construction of the heavy bridges.

4. Fire support for the advance to bridgehead positions

i. *Artillery*.—Artillery support will be required by the assaulting troops for their advance to their bridgehead positions. This support will include concentrations against enemy centres of resistance and harassing fire against reserves moving up to counter-attack. Guns must be sited well forward to provide this fire, and F.O.Os. should cross early in the assault. Counter-battery tasks may also be of urgent priority, particularly if bridging operations are restricted to sites which are likely to be obvious to the enemy.

ii. *Air*.—Air observation for the artillery will be valuable at this stage if there are difficulties of communication between F.O.Os. and battery positions, or if targets, such as enemy gun positions and reserves, are not visible to F.O.Os. All available air O.P. sections should therefore be allotted to artillery regiments supporting the attack. Reports of the moves of enemy reserves will be of the greatest assistance to commanders. Other roles include direct support bombing and "ground strafing" against any centres of resistance holding up the advance (particularly valuable when the attack has penetrated beyond the effective range of the supporting artillery), harassing tactics against enemy reserves moving to counter-attack, and neutralization of enemy artillery.

5. Bridgehead requirements

Bridgeheads must be extended from the initial positions gained by the first wave of the assault to well established defensive positions strong enough to resist any attempts by the enemy to interfere with the actual work at the bridge or ferry site, and to cover the crossing of the main body.

A single bridgehead may cover one or more crossing places, but must initially be at least deep enough to cover the sites from small arms fire, thus facilitating the crossing of subsequent waves in boats and on foot bridges. Before work is started on the bridges or rafts, every effort must be made to extend bridgeheads to the second objective from which the sites are covered from ground observed artillery fire ; otherwise damage to bridging equipment may endanger the whole plan.

Should it be necessary in exceptional circumstances to launch tank assault bridges, or to construct rafts or light bridges, before bridgeheads can be extended sufficiently to exclude ground observed artillery fire, smoke must be used to blind enemy observation. Otherwise, by day, excessive casualties will result.

As soon as possible bridgeheads will be extended to the third objective, from which all artillery fire on the bridge sites is excluded. Use of the means of crossing without interruption by ground action is thus established.

6. Local defence of bridge sites

At each bridge site an officer must be appointed to co-ordinate the arrangements for its local defence. He should NOT be the engineer officer in charge of the bridging operations. In the event of enemy counter-attack he must command all troops in the vicinity, whether they are located there for the defence of the bridge, working on its construction, or, later, actually crossing. Troops must remain in position for ground protection of the bridges until a sufficient force has crossed to remove the danger of enemy counter-attack. Arrangements need then be made to guard against sabotage and attack by enemy airborne forces only.

7. Use of raft ferries to "build up" the bridgehead defence

"Raft ferries" can be used under certain conditions to provide a means of crossing for a limited number of vehicles earlier in the operation than would otherwise be possible. Their use may, however, tend to delay the passage of the force as a whole, since the use of equipment in this role will usually retard bridge construction. The decision to use them or not needs careful consideration. The commander's aim is to get his main striking force as a whole across the obstacle as rapidly as possible ; on the other hand, the bridgehead force will be vulnerable to counter-attack, especially by A.F.Vs., until some of the heavier supporting weapons and transport are across. The following are the more important factors

which the commander will have to consider in deciding on his plan for the progressive " building up " of bridgeheads :—

i. Degree of enemy resistance anticipated in the advance to bridgehead positions.

ii. Extent and timing of possible enemy counter-attacks (immediate and deliberate).

iii. Technical considerations—e.g., possibility of using rafts, comparative timings for construction of rafts and bridges of the same load classification, rate of delivery of vehicles on the far bank by ferry under the conditions prevailing.

iv. Equipment available.

8. Advantages and disadvantages of rafts

The comparative advantages and disadvantages of rafts over bridges of similar load classification may be summarized as follows :—

i. *Advantages*

(*a*) For wide obstacles, under favourable conditions, they provide an earlier means of crossing for a *limited number of vehicles.*

(*b*) For a given amount of equipment a greater number of crossing points can be established.

(*c*) They are not so vulnerable to enemy action.

(*d*) Rafting is very much more flexible than a bridge. If the approach is made unusable by enemy action, the raft can be moved elsewhere quickly, whereas the bridge cannot.

ii. *Disadvantages*

(*a*) Some water obstacles are unsuitable for the use of ferries owing to the nature of the banks and bottom, others may so reduce the rate at which loads can be shipped and delivered that all other advantages are outweighed (e.g. double obstacle).

(*b*) Even under favourable conditions their capacity in terms of vehicles delivered on the far bank in a given time is very much less than that of a bridge.

(*c*) With limited equipment it may be impossible to complete the bridges while the rafts are in use.

(*d*) The employment of engineers to construct and operate rafts, combined with (*c*) above, may delay construction of bridges.

9. Use of light bridges to "build up" the bridgehead defences

The divisional commander is faced with a similar problem in deciding whether :—

i. First to build light bridges and then the heavy ones, or

ii. to concentrate his engineer resources on starting immediately construction of the heavy bridges.

Though in this case the technical considerations are different from those relating to raft ferries, the two problems are inter-related and should be considered together.

If the gap is too wide to be spanned by available tank assault bridges, tanks cannot, without heavy rafts, cross until a heavy bridge is constructed. On the other hand, light bridges are quicker to construct than heavy ones, the difference in time varying with the width of the gap, approaches, etc., and they will carry all the fighting vehicles of the division except tanks. Until carriers, trucks with mortars, M.M.Gs., anti-tank mines, A.A. guns, etc., can cross, bridgehead troops are very vulnerable to counter-attack. Whether it is possible to meet these requirements by the use of light rafts depends on the number of vehicles required and the nature of the obstacle. Against any but the lightest opposition it will be essential in the first phase to build either light bridges or rafts because of the time required for the construction of heavy bridges.

For narrow gaps, because the difference in time taken for the construction of heavy and light bridges is smaller, the immediate construction of heavy bridges may be advantageous. For example, a small box girder class 40 bridge can be built over a gap of 48 feet, and the difference in time taken for the construction of a light bridge is negligible.

Generally the crossing of the division as a whole will be quicker if light bridges as well as heavy bridges are constructed, since the move of the majority of the vehicles over the obstacle can be begun earlier.

7.—CONSTRUCTION OF BRIDGES AND CROSSING OF THE MAIN BODY

1. Construction of bridges

i. *General considerations*

The construction of bridges on a sufficient scale for a crossing in the face of heavy opposition, particularly from the air, together with the other engineer tasks likely to arise in con-

nection with the repair of routes, will often demand the use of the corps troops engineers.

Divisional engineers should be employed on those tasks demanding close co-operation with the division.

ii. *Erection of bridges*

This task may consist of the erection of new military bridges or the repair of partially demolished ones. It will frequently be easier from the technical point of view to use the site of the demolished or partially demolished bridges. It is in any event a straightforward engineer task. If the site has been contaminated with a persistent gas, the time of construction will be increased considerably (probably more than doubled). Early information of ground contamination of sites will greatly assist the engineers.

Depending on the bridging plan, this phase of the crossing may or may not be divided into the following stages :—

Stage 1—Construction of rafts and crossing of vehicles essential for bridgehead defence.

Stage 2—Construction of light bridges and crossing of light vehicles.

Stage 3—Construction of heavy bridges and crossing of main body.

If the equipment and engineers are available, and the tactical situation permits, subsequent stages may begin before the preceding stages are completed.

iii. *Construction of approaches and exits*

This is usually a longer and much more difficult task than the erection of the bridge. Until the exact site of a bridge has been decided, and a detailed examination of the approaches and exits has been made, it is not possible to estimate the time required for completion.

For heavy bridges the work otherwise involved in the construction and maintenance of "made up" approaches for wheeled vehicles will usually result in their being built on or adjacent to the site of demolished bridges, to economize in time and labour.

It will frequently be necessary to provide infantry working parties to obviate undue delay in opening the bridges to traffic.

iv. *Maintenance of bridges and approaches*

Normal wear and tear, and possibly damage caused by enemy action, necessitate maintenance. It may frequently be necessary to close the bridge temporarily to traffic for this purpose or because of tidal conditions. At such times the divisional movement plan and traffic control will be affected.

For all bridges a local reserve of equipment must be maintained for repairs. Maintenance of "made up" approaches will always require infantry working parties.

2. Orders for work on bridges to start

As soon as a bridgehead has been established work on bridges and rafts must begin.

An engineer officer is appointed in charge of the construction at each site. The order to start work may be given by the divisional commander through the C.R.E., but unless complete reliance can be placed on communications between the assaulting troops and divisional headquarters, and between the C.R.E. and the officers in charge of bridge construction, it will be advisable to delegate the authority to the commander of the assaulting brigade or, when the front is a wide one, to leading battalion commanders.

As much preliminary work at the sites as possible should be carried out before the establishment of the bridgeheads. It may frequently be possible to do a considerable amount before the assault is launched, but instructions and co-ordination are necessary in order that surprise may not be prejudiced. These are the responsibility of the commander to whom the authority for ordering work on the bridge construction has been delegated.

3. Crossing of the main body

Fighting units not required for the assault and establishment of bridgeheads should be organized into a striking force in the assembly area. When operating against a retiring enemy, or when the situation is favourable for a deep thrust, it will often be advisable to pass this force over the obstacle as soon as the bridges have been completed, and before passing any but the essential vehicles of the troops who have been engaged in the establishment of bridgeheads. In the armoured division the armoured brigade is suitable for employment in this role, the infantry brigade being responsible for forcing the crossing and establishing bridgeheads, and protecting them.

As soon as a bridge is completed, information must be sent back to divisional headquarters, who will then order units forward through the traffic control organization (or instruct leading brigades to begin crossing). The plan for the move must be prepared beforehand, and it must be flexible. Variations can be readily effected through the traffic control organization.

If the bridging plan includes the construction of light bridges which will not carry all loads in the division, as well

as one or more heavy bridges, it will normally be convenient to divide serials into two groups : one group which can cross by light bridges, and a second which must cross by the heavier bridges. In units with vehicles in both classes, a decision must be made whether each unit as a whole should cross by the heavy bridge. Units having been divided into serials, a provisional allotment (with timings) should be made to the bridges planned. Timings at this stage must be on a zero basis, and generous time gaps allowed between blocks of serials. Block timings for individual serials may be calculated on the basis of 5 m.i.h. at 30 v.t.m. as a maximum.

For blocks of serials the capacity of military bridges will not exceed 100 vehicles per hour ; and over a period allowing for interruptions required for maintenance 60 vehicles per hour.

Vehicles at 30 v.t.m. offer a favourable air target, the danger of moving at this density varying with the time of day, the weather, the degree of air superiority, and the anti-aircraft defences available. The possibility of a complete block being caused at the approaches or exits must always be balanced against the desire for a quick crossing by individual serials. It may be desirable to alter the density for different times of the day, and to decrease it for serials crossing during the later stages of the operation for which the same urgency for a rapid move does not exist.

If two or more bridges of the same load capacity are planned it may be convenient to allot a combined priority for all serials of that load classification, to ensure that, if one of the bridges is damaged or destroyed, the order of movement on the remaining bridge or bridges is clear.

4. Recovery and replacement of bridging equipment

Arrangements must be made well beforehand for the replacement of the divisional bridging equipment used in the crossing. The replacement will usually be made from the corps bridge company.

The salvage of assault equipment is the duty of the infantry. It should be delivered to rendezvous laid down in divisional orders, where the engineers will take it over.

8.—METHODS OF CROSSING

1. Service equipments

The following is a list of standard service equipment available for the purposes indicated. With the exception of the types marked * they are an engineer responsibility.

For items marked † the purposes indicated are alternative methods of using the equipment shown available, in column 3.

Equipment can, of course, be used for a combination of purposes.

Type 1.	*Description* 2.	*Where carried* 3.
For reconnaissance and infantry assault		
1.*Reconnaissance boat.	Pneumatic rubber boat carrying 2 men.	8 with each Fd. Sqn. 15 with Fd. Pk. Sqn. 5 with each Fd. Coy. 17 with Fd. Pk. Coy. 120 with Br. Coy.
2.*Assault boat.	Collapsible boat of plywood and canvas, carrying 9 men.	288 with Br. Coy. (a proportion may be carried in Fd. Pk. Sqns. and Coys.).
	or	
	similar but stouter boat carrying 18 men.	144 with Br. Coy. (a proportion may be carried in Fd. Pk. Sqns. and Coys.).
3.*Kapok assault bridge.	Kapok floats and duckboards. Not suitable for use in swift currents	90 bays (585 ft.) with Br. Coy.
4.†Folding boat.	From folding boat bridging equipment. Carries 16-20 fully armed men plus crew of 5 sappers.	16 boats with Fd. Pk. Coy. 32 boats with Br. Coy.
5. Light rafts for M.Gs. and A.Tk. guns.	May be improvised from any of the above.	Spare Kapok Floats carried in Br. Coy.
For Bren carriers, trucks, and 30-cwt. lorries		
6.†F.B.E. decked raft (single bay).	2 folding boats and 1 bay superstructure. For ferrying Class 5 loads. Landing stage required.	6 decked rafts and 2 landing stages from equipment with Fd. Pk. Coy. 14 decked rafts and 2 landing stages from equipment with Br. Coy.
7.†F.B.E. shore loading raft.	3 folding boats and 2 bays of superstructure with special fittings. For ferrying Class 5 loads no landing stage required.	2 rafts from Fd. Pk. Coy. 4 rafts from Br. Coy.
8.*Bridges, track, 12-ft. (Class 5).	2 types—one for Class 5 wheeled and one for Class 5 tracked vehicles. Pairs of braced steel tracks for 10-ft. gaps. No. 1—Class 5 wheeled vehicles; No. 2—Class 5 tracked.	Held in engineers store base depots and engineer dumps. Available on demand.

Type 1.	*Description* 2	*Where carried* 3.
Light tanks and vehicles up to Class 9		
9.†F.B.E. bridge.	Decked rafts connected together in bridge, with or without trestle landing bays.	200 ft. of bridge with Fd. Pk. Coy. 400 ft. of bridge with Br. Coy.
10.†F.B.E. decked raft (double bay).	4 folding boats and 2 bays superstructure. For ferrying Class 9 loads. Landing stage required.	3 decked rafts and 2 landing stages from equipment with Fd. Pk. Coy. 7 decked rafts and 2 landing stages from equipment with Br. Coy.
11.*Bridges, track, 12-ft. (Class 9).	Similar to 8.	As for 8.
Tanks and vehicles up to Class 24		
12. Small box girder.	1 SPECIAL set will make :— 1 64-ft. Class 24 (4 girder) *or* 1 48-ft. Class 40 (4 girder.)	2 special sets with Fd. Pk. Coy. 4 special sets with Br. Coy. 1 special set with Fd. Pk. Sqn.
13.†Pontoon rafts.	3 pontoon piers with superstructure. Landing stage required.	10 rafts and 2 landing stages from equipment with Br. Coy.
14.†Pontoon bridge.	Rafts connected together in bridge, with or without trestle landing bays. *To be superseded by the Bailey pontoon bridge* (see (20) *below*).	4 120-ft. bridges with Br. Coy.
15. Scissors bridge, No. 1.	Folding, steel tracked bridge mounted on a special tank, mechanically operated. For 30-ft. gaps.	3 per Armd. Bde.
16. Bridges Track 20 ft.	Similar to 8. Carries Class 24 tracked vehicles, Class 18 6 wheeled vehicles, Class 12 4 wheeled vehicles.	4 pairs with Fd. Pk. Sqn.

Type 1	*Description* 2.	*Where carried* 3.
Tanks and vehicles up to Class 40		
17. Small box girder.	*See* 12 above.	
18†. 40-ton raft.	1 64 ft. Class 24 small box girder bridge on 6 pontoon piers.	2 rafts from equipment with Br. Coy.
19†. 26-ton pontoon shore loading raft.	A raft constructed of pontoon landing bay girders on 4 Mk. V pontoon rafts. Special connecting parts required.	Rafts from equipment with Br. Coy. *Superseded by 26-ton decked pontoon raft (Bot wing.)* *Equipment for 1 raft carried in Br. Coy.*
20. Inglis tank assault bridge 84 ft. span.	Class 30 loads.	Experimental and scale not decided.
21. Bailey tank assault bridge 80 ft. span.	Class 40 loads.	Experimental and scale not decided.
22†. Bailey bridge.	A through girder bridge of steel panels with timber roadway.	1 130 ft. Class 40 bridge (divisible into 2 shorter bridges) carried in Br. Coy.
23†. Bailey pontoon bridge.	Bailey bridge on pontoon piers with special pontoon sections added.	Floating bridge parts to make with 22 268 ft. Class 40 floating bridge. Carried in Br. Coy.
24. Tank Bridge No. 2.	Similar to 15, carrying Class 55.	Not yet available.
Tanks and vehicles up to Class 70		
25†. Bailey bridge.	Similar to 22 above. Extra girders required according to span.	Carried in Br. Coy. Reserves with Workshop and Park Coy. R.E.
26†. Bailey pontoon bridge.	Similar to 23 above. Extra girders required for landing bay, and pontoon piers closer together.	Carried in Br. Coy. Reserves with Workshop and Park Coy.

2. Improvised methods

The quantity of service equipment available may often fall short of requirements or may not be readily procurable. Units can often do a lot to help themselves without waiting for equipment or engineer assistance.

In addition to the improvised rafts mentioned in 1 above, the following are methods by which units can get some, if not all, of their vehicles across a water obstacle :—

i. Rafts constructed from local resources, e.g. barrels, or petrol tins and timber.

As a rough guide, petrol tins, etc., will carry a load of 8 lb. per gallon capacity.

ii. Light vehicles (8 or 15 cwt. trucks) if wrapped in a tarpaulin or watertight jacket made from vehicle covers can be floated and towed across.

iii. Bren carriers can propel themselves across if kapok floats are attached to the sides and holes in the body are plugged.

iv. By fastening kapok floats to the gun, anti-tank guns can be floated and pulled across by hand. (The breech block must first be removed and carried across in a boat.)

v. Given gently sloping banks and a firm bottom, anti-tank and field guns can be pulled through the water using the winch and cable on the tractor, either from the far bank, the tractor having crossed by raft, or from the near bank using a snatch block.

vi. Men can cross without wetting their equipment or clothing by wrapping them in a ground sheet, and pushing the " float " so formed in front of them as they swim across. Full details are given in Military Training Pamphlet No. 30, Part III.

3. Fords

The maximum fordable depths of water :—

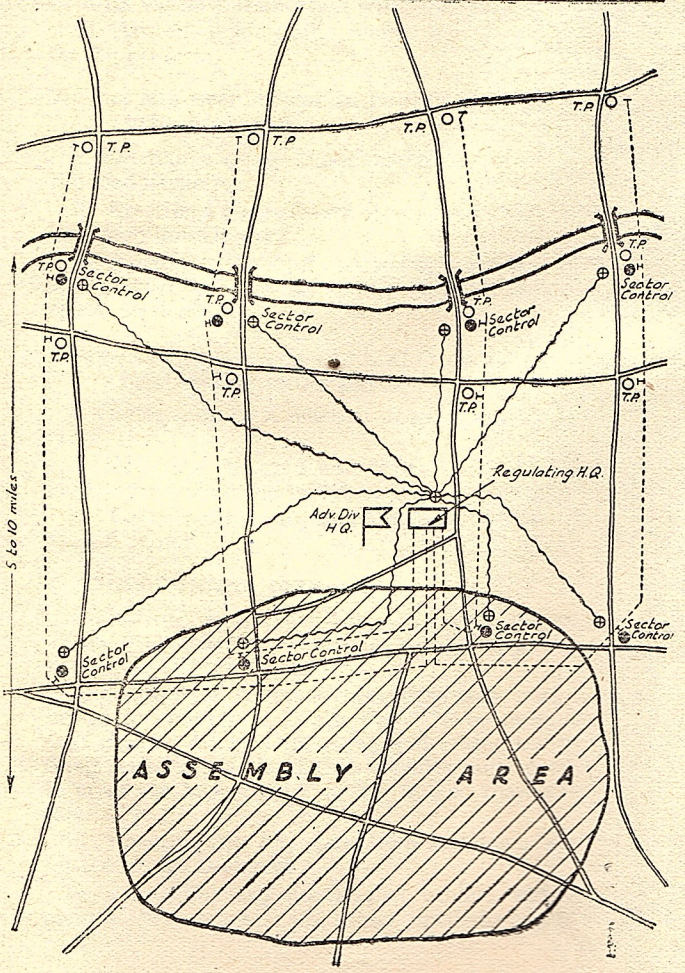
Motor cycles	1 ft.
Armoured cars, cars, and trucks ...	1 to 1 ft. 6 ins.
Lorries and heavy ambulances ...	2 ft.
Bren carriers and light tanks	3 ft.
Heavy tanks	3 to 3 ft. 6 ins.

[To face page 40

DIAGRAMMATIC LAYOUT OF TRAFFIC CONTROL

(Crossing necessitating a deliberate assault).

- Regulating H.Q.
- Sector Control.
- Traffic post.
- Line communication.
- Wireless communication



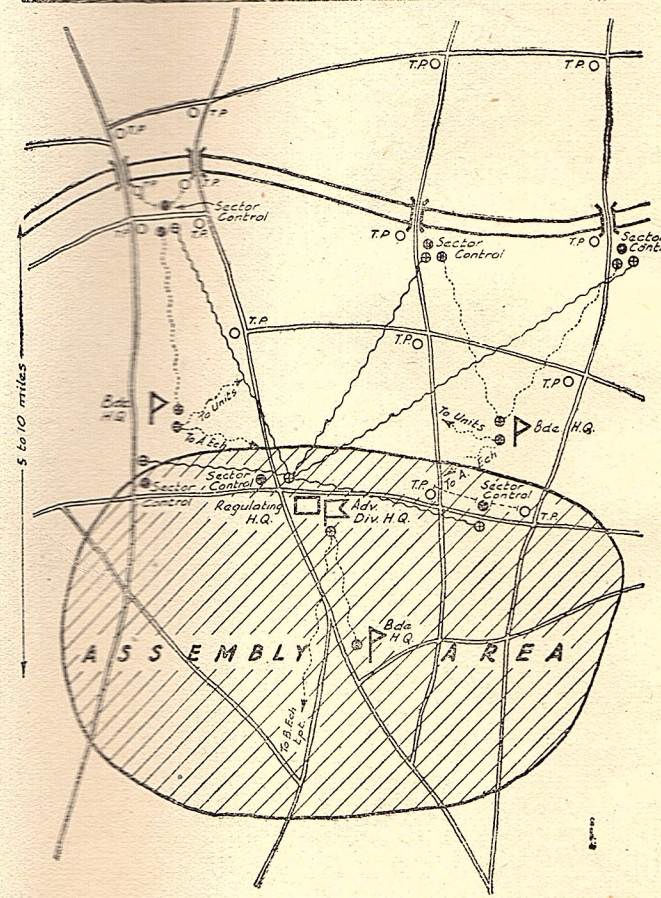
DIAGRAMMATIC LAYOUT OF TRAFFIC CONTROL

(Rapid Crossing)

- Div wireless communication
- Div line communication
- Bdes wireless communication

NOTES

1. Leading bdes allotted two routes each and block timings
2. TPs and Sector controls should be connected up by line communication as time permits



APPENDIX B

RESPONSIBILITIES FOR TRAFFIC CONTROL AT BRIDGES AND FERRY SITES

1. The staff

i. Ordering the classification of any bridges captured.

ii. Arranging that vehicles are ordered forward to bridges or rafts whose classification will permit their passage.

iii. Arranging for traffic control on the approach road and on the bridges.

2. The engineer officer in charge of the erection of the bridge or raft

i. Erecting a bridge classification sign at each end showing the load capacity.

ii. Erecting a notice board at each end of the bridge showing the speed limit if any.

iii. Notifying the staff and traffic control personnel at the site when it is ready for use, the load classification, and any speed restrictions.

3. The engineer officer or N.C.O. in charge of bridge or raft maintenance party

i. Giving a decision whether or not unclassified vehicles may cross.

ii. Notifying the staff and traffic control personnel if it is necessary to close the bridge or raft for repairs.

iii. Control of the raft, and a decision whether it is correctly loaded or not.

4. Traffic control personnel

i. Erecting a classification sign, and diverting vehicles which are too heavy to cross, at a suitable point on the route leading to the bridge or ferry.

ii. Controlling traffic on the approach road and on the bridge to maintain a steady flow. They must bear in mind that military bridges are capable of taking traffic only in one direction at a time, and that vehicles must never be allowed to cross the bridge more closely spaced than 80 feet head to tail.

iii. Ensuring that any speed limit laid down by the engineers for the bridge is obeyed.

iv. Preventing any unclassified vehicle, either military or civilian, from crossing the bridge until the engineer officer or

N.C.O. in charge of bridge maintenance party has decided that it may cross.

5. Units

i. No overloading of vehicles.

ii. Each driver to know the maximum loaded weight of his vehicle, and the meaning of bridge classification signs erected at the approaches to bridges.

iii. *Drivers to be trained to understand :—*

(*a*) It is as much their responsibility not to attempt to cross a bridge which is of a lower classification than their vehicles, as it is not to force a sentry.

(*b*) That, when crossing a bridge, they must proceed at a slow, even speed and refrain from rapid acceleration or sharp braking—particularly with tracked vehicles.

iv. Ordering drivers as requested by the officer or N.C.O. in charge of the maintenance party or by traffic personnel.

v. An officer of each unit will remain on the near side of the bridge or raft to control the movement of his unit until the whole of it has passed.

APPENDIX C

SPECIMEN SEQUENCE OF EVENTS

As a general guide to the sequence of events that occur between the actual assault and the crossing of the main body, the following time table for an imaginary crossing is given. It is emphasized, however, that only in so far as the sequence of events is concerned is the example of general application ; the details of the means of crossing, the timings, etc., will of course vary in every operation.

The attack is a daylight one on an organized defensive position behind a river 80 yards wide.

Zero	Our artillery opens fire on close support weapons of the defence with a mixture of H.E. and smoke. Assault troops advance to river from "forming up" places.
Zero + 10 mins.	Artillery lifts to harassing tasks. Assaulting infantry cross the obstacle under cover of the smoke and their close support weapons, by wading, swimming, local craft, or assault boats.

Zero + 25 mins	Artillery fire supports advance by fire on specific targets reported by F.O.Os. and air. Assaulting infantry advance to first objective. Local reserves cross, anti-tank artillery and infantry close support weapons begin crossing on improvised rafts. R.E. advance parties start preliminary work at bridge sites.
Zero + 40 mins.	Assaulting infantry report having reached objectives. Construction of light raft ferries begun. Construction of heavy raft ferries begun. To get essential A.F.Vs., guns, and vehicles required for bridgehead defence across.
Zero + 1¼ hrs.	Light rafts completed. Vehicles and weapons required by assault troops for consolidation of bridgehead position start crossing. Construction of light bridges begun.
Zero + 2½ hrs.	Heavy rafts completed. Proportion of tanks cross for bridgehead protection. Construction of heavy bridge starts.
Zero + 4½ hrs.	Light bridges completed. Remaining vehicles required by bridgehead troops cross. Crossing of main body begins.
Zero + 9 hrs.	Heavy bridges completed. Tanks and main body complete crossing.
Zero + ?	Light bridges dismantled.

APPENDIX F

SCALES OF BRIDGING EQUIPMENT CARRIED IN THE FIELD

	Inf. Division	Armoured Division		Corps
	Fd. Pk. Coy. R.E.	Fd. Pk. Sqn.	Armd. Bde.	†Bridge Coy. R.A.S.C.
(*a*) Reconnaissance boats ...	17 (also 5 per Fd. Coy.)= 32 total per Div.	15 (also 8 per Fd. Sqn.)= 31 per Armd. Div.	—	120
(*b*) Assault boats	—	—	—	288
(*c*) Kapok assault bridge ...	—	—	—	‡585 ft.
(*d*) Folding boat bridge equipment.	200 ft.	—	—	400 ft.
(*e*) Pontoon, Mark V, bridge equipment.	—	—	—	*4—120 ft. Cl 24 bridges.
(*f*) Bailey bridge	—	—	—	1—130 ft. Cl 40 bridge divisible into 2 80 ft. Class 40.
(*g*) Bailey pontoon bridge ...	—	—	—	Sufficient pontoons carried to make with (*f*) above 268 ft. Cl. 40 floating bridge and 2 Cl. 40 shore loading rafts.
(*h*) Small box girder bridge	2 special sets	1 special set	—	4 special sets.
(*i*) Scissors bridge	—	—	3	—
(*j*) i. Bridges, track, 12 ft. (Class 5, and 9). Available on demand (held at Eng. Base Dumps).				
ii. Bridges, track, 20 ft. { Class 24 tracked vehicles. / ,, 12 wheeled ,, }			4 pairs.	
(*k*) 26-ton pontoon decked raft (Bot wing).	—	—	—	Sufficient for 1 raft.
(*l*) Class 30 Inglis tank assault bridge, 84-ft. span.	Experimental; scales and where to be carried not yet decided.			
(*m*) Class 40 Bailey tank assault bridge, 80-ft. span.	Experimental; scales and where to be carried not yet decided.			

NOTE.—*Either (*e*) and (*k*) or (*g*) will be available. Bailey pontoon (*g*) supersedes pontoon, Mark V.

† This is the standard Bridge Company. It can be reinforced as necessary by the allotment of mobile reserve components from Workshop and Park Company R.E.

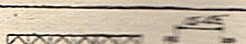
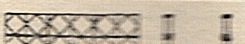
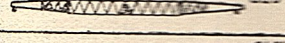
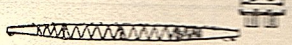
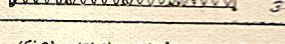
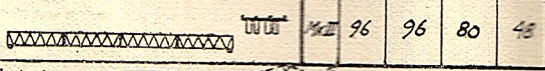
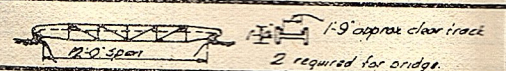
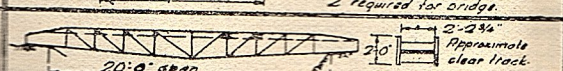
‡ Spare floats are carried in addition for floation (e.g. rafts, carriers, etc.)

Printed under the Authority of HIS MAJESTY'S STATIONERY OFFICE
by Keliher, Hudson & Kearns, Ltd. London S.E.1.
(17220) G.837 250,000 8/42 **Gp. 8/7**

[To face page 44.

NON-FLOATING EQUIPMENT - BRIDGES - CLASSIFICATION.

Appendix D.

TYPE	OUTLINE	MAXIMUM SPANS FOR GIVEN LOAD CLASSIFICATION										REMARKS.
		5	9	12	16	24	30	40	50	60	70	
BAILEY. Single truss: Single storey					60	60	50	30*				In single storey bridges, transoms are placed behind uprights. In double storey bridges, transoms are placed in front of uprights. For bridges over "class 40" all transom positions are occupied, i.e. double transoms every 5'-0". * Can be increased to 50 in cases of emergency. † Subect to confirmation by test. The centres of the shore transom must be supported on packing in bridges for loads over class 24.
BAILEY Double truss: Single storey					120	110	90	80	† 60	† 50	† 40	
BAILEY. Triple truss: Single storey					140	140	120	110	† 90	† 80	† 70	
BAILEY Double truss: Double storey.					† 160	150	140	130	110	† 100	† 90	
BAILEY Triple truss: Double storey.					† 160	† 170	160	150	† 130	† 120	† 110	
SMALL BOX GIRDER: 2 girder with hornbeams		Mk II	80	64	64	48	32					The use of girders without hornbeams is uneconomical and should, if possible, be avoided. For spans over 64' sway bracing must be used. Mark II components are not interchangeable with Mark III. Separate bankseats are provided according to girder spacing, viz. 2 or 4 girders. For 3 girder use "2 girder" bankseat.
SMALL BOX GIRDER: 3 girder with hornbeams.		Mk III	96	80	64	48	48					
SMALL BOX GIRDER: 4 girder with hornbeams.		Mk II	96	96	80	64	64	48	48	32		
SMALL BOX GIRDER: 2 girder without hornbeams		Mk III	80	32								
SMALL BOX GIRDER: 3 girder without hornbeams		Mk II	96	80	48							
SMALL BOX GIRDER: 4 girder without hornbeams.		Mk III	96	96	80	48	32					
SCISSORS												Not R.E. equipment: is carried by R.A.C.
12 FT. TRACK BRIDGE.												Tracks can be laid to any centres. Note: Three types of bridges.
20 FT. TRACK BRIDGE												Tracks can be laid to any centres.

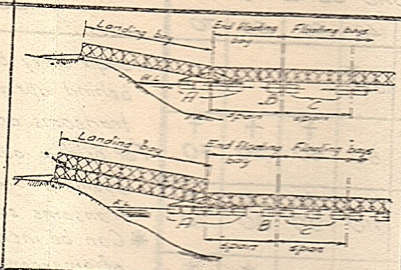
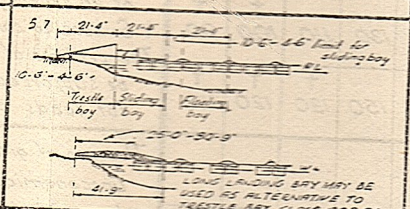
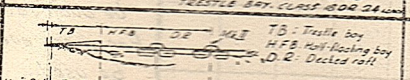
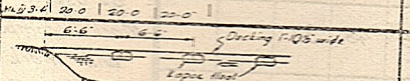
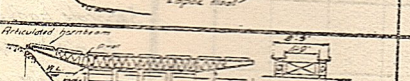
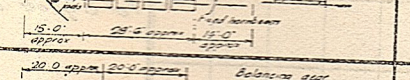
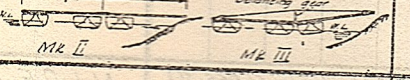
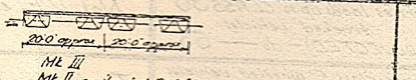
No 1 carries loads up to CLASS 30 tracked vehicles.
No 2 (PROJECTED) — do — 55

No 1 carries class 5 wheeled vehicles
No 2 — do — 5 tracked — do —
"Bridges 12 feet" class 9 — for wheeled vehicles will also take class 12 tracked vehicles.

Carries all class 12 vehicles, Class 18 vehicles (not 4 wheelers) & Class 24 tracked vehicles

FLOATING EQUIPMENT - BRIDGES & RAFTS - CLASSIFICATION

Appendix. E.

TYPE	OUTLINE	LOAD CLASSIFICATION	REMARKS
BAILEY PONTOON		MAXIMUM SPAN FOR GIVEN LOAD CLASSIFICATIONS LANDING BAY: CLASS 24 / 30 / 40 / 50 / 60 / 70 FLOATING BAY: CLASS 24 / 30 / 40 / 50 / 60 / 70 Single truss, Single storey: 60 / 50 / 40 — — — — — 52 / 42 / 42 — — — Double truss, Single storey: 110 / 90 / 80 — — — 40 — — — — — 32 Triple truss, Single storey: 140 / 120 / 110 — — — 70 Double truss, Double storey: 150 / 130 — — — 90 PROHIBITED No OF PONTOONS REQUIRED. Landing bay "A": 4 / 4 / 4 / / / 6 End Floating bay "B": 1 / 1 / 1 / / / 1 Floating bay "C": 2 / 2 / 2 / / / 3	Transoms to be arranged as stipulated for non-floating Bailey bridges. Pontoons:- 2 Mk V pontoons with special centre section Class 40 and above: the end floating bay cannot exceed 32'-0"
PONTOON MK V		Floating bays:- 3 pontoons per bay carry loads up to Class 24. With 3 pontoons Class 30 loads can be carried if 10 extra roadbearers are laid across the junction of each three pier rail. The ends must be formed with long landing bays, or, S.B.G's. (4 girders 48 feet maximum length). Sliding bays and trestles are not strong enough for Class 30 2 pontoons per bay carry loads up to Class 18	Clear roadway: {9'-0" with kerbs / 8'-8" without kerbs} All bays are 21'-4". Half Floating bays must always have 2 pontoons. Limiting height of trestle bay above water 3'-2"-4'-9" Long landing bay is a built-up girder similar to S.B.G.
FOLDING BOAT EQUIPMENT MK III		Carries loads up to class 9	Clear width of track: {9'-1" Mk II / 8'-7" Mk III} Limiting height of transoms above water: {0'-2'-6" Mk II / 6'-4'-0" Mk III}
KAPOK ASSAULT		Carries infantry in single file at 6'-0" intervals.	If 'L' = width of river in feet: No of floats & transoms reqd. = $\left(\frac{L \times 2}{13}\right) - 1$ No of deckings reqd. = $\frac{L \times 2}{13}$
PONTOON MK V SHORE LOADING RAFT		Carries tanks and wheeled vehicles up to 26 tons weight	Overall length approx. 57'-6" Superstructure is constructed of Pontoon landing bay girders with special connecting parts Max. height: bank above water 5'-9"
FOLDING BOAT EQUIPMENT SHORE LOADING RAFT		Carries loads up to class 5	Overall length 40'-0" approx. Can be used where maximum height of bank above water is less than 3'-0". Clear road track: {9'-1" Mk II / 8'-7" Mk III}
FOLDING BOAT EQUIPMENT DECKED RAFT		Carries loads up to class 9. Single bay raft carries loads up to class 5	Can only be used where there is an properly constructed landing stage. Clear road track: {9'-1" Mk II / 8'-7" Mk III}
PONTOON MK V (S.B.G. SUPERSTRUCTURE) 40 TON RAFT.		Mk V pontoons with "4 girder" S.B.G. Mk III. Girder spacing determined by special spacing pieces Carries tracked vehicles up to 40 Tons.	Limiting heights of bank:- maximum 3'-0" minimum 1'-3" Minimum depth of water, 2'-6" at 15'-0" from end of hornbeam

CONTENTS—*Continued*

(*Continued on page* iv)

CONTENTS—*Continued*

This manual has been scanned by the

Vickers MG Collection & Research Association

www.vickersmg.org.uk

Please support the work of the Association.

Click on the image to donate through PayPal:

Or regularly support us through Patreon:

Or make a quick, single donation:

A not-for-profit company, limited by guarantee, registered in England, Company Registration Number 07855202